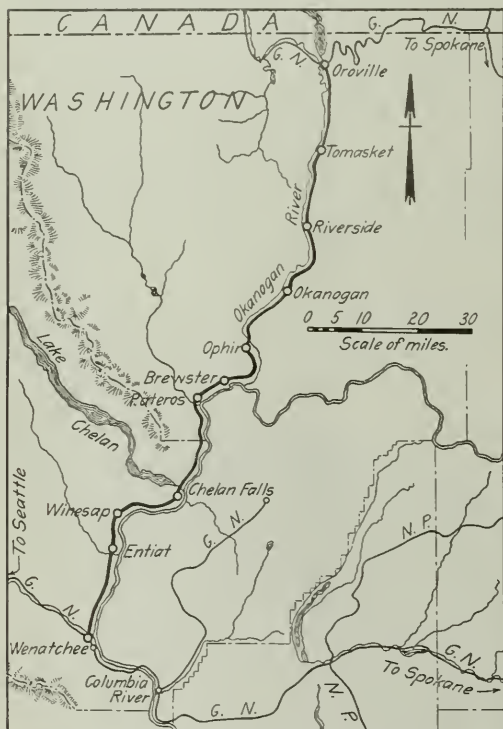


New G. N. Line from Oroville to Wenatchee

Road Serves an Area Previously Without Facilities,
Providing Low Grade Line from British Columbia East

The Great Northern has been working for three years on the construction of a line north from Wenatchee, Wash., to Oroville. The main line of the Great Northern crosses the state of Washington from Spokane to Seattle north of the Northern Pacific and St. Paul roads, and about 100 miles south of the Canadian border. A branch line of the Great Northern runs north from Spokane to the international border and then west, generally parallel to this border to the Cascade mountains. A third line runs north from Seattle along Puget Sound to Vancouver, while another line is now building east from Vancouver to a connection with one extending west along the international boundary. With the exception of a few branch lines of the Northern Pacific along the western coast and one adjacent to

orchards, although the only transportation heretofore has been daily packet service on the Columbia river as far north as Brewster, and stage transportation beyond. This new line starts from a connection with the main line at Wenatchee and extends north along the west bank of the Columbia river to Brewster, from which point it follows the Okanogan river to a



Map of Wenatchee-Oroville Line of the Great Northern

the main line of the Great Northern from Spokane west to Adrian and a short branch of the Great Northern east of the Columbia river, this area 200 miles long by 100 miles wide has been without railway facilities. While this area includes the Cascade mountain region, much of it is productive land suitable for wheat and fruit raising.

Early in 1910 the Great Northern undertook the construction of a new line extending through the center of this area north and south. Due to various complications, actual construction work on the southern half of this line was delayed until the spring of 1912, and the grading for the entire line has only recently been completed. This road will provide transportation facilities for a large area, much of which is already set out in



One of the Tunnels With Highway Overhead

connection with the east and west line along the border, at Oroville, a total distance of 134 miles.

With the completion of the new line, the Great Northern has two lines from Oroville to Spokane. The older line running east along the boundary has heavy grades and curvature, and is therefore expensive to operate. The new line from Oroville to Wenatchee is built with a maximum grade northbound of 0.4 per cent., and southbound of 0.3 per cent., and with 4 deg. curves the sharpest, except at M. P. 40, where three 5 deg. curves are inserted. As southern British Columbia, through



Typical Point Projecting into River

which the old line passes west of Oroville, originates much fruit and other traffic, it is expected that a large proportion of this will eventually be sent over the new line via Wenatchee to Spokane. Thus, in addition to providing railway facilities for a large area previously undeveloped, this line also gives a low grade outlet for a considerable amount of traffic.

Owing to difficulties in completing negotiations with the state

for certain necessary changes in the state highway near Wenatchee, work was started first at the north end of the line. The grading of that portion of the road between Oroville and Pateros was started in 1910, but due to the delays in completing negotiations further south the work at the north end was not pushed and the bridges and track laying on this section were not completed until early in the spring of 1913. Grading on the portion of the line south of Pateros was started early in 1912, and was completed late in the fall of 1913. All track has now been laid.

The relocation of Washington State Road No. 10 was the



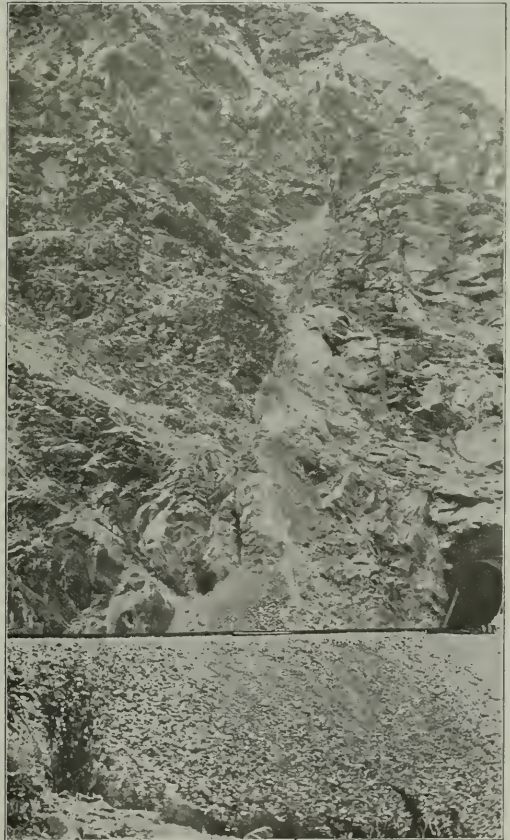
Bluff Debris Encountered on Mile 23

most complicated problem in the construction of this line of railroad. At frequent intervals throughout the lower 27 miles of the line the railroad location occupied the highway, and necessitated the relocation of the highway. The points where relocation was necessary were usually around steep rock bluffs, and building of the railroad at such points was rendered about doubly expensive and very complicated by providing a roadbed for the highway, as well as for the railroad. In all 13 miles of wagon road was rebuilt in three stretches, at a total cost of over \$100,000. The accompanying photographs show the railroad with reference to the reconstructed highway at some of the steepest bluffs. It was necessary to maintain continuous traffic over these highways, so the new roads had to be built before the old ones could be abandoned, which, of course, had to be done before the railroad grade could be built. The specifications under which the new highway was built were furnished by the state engineer, and required a roadbed 10 ft. wide, with frequent turnouts, 100 ft. long where the roadbed is 16 ft. wide, and protected with a substantial fence on the embankment side. The maximum gradient allowed on the wagon road was 7 per cent.

At Destruction Point, a few miles north of Wenatchee, it was necessary to move over 200,000 cu. yd. of rock and one steam shovel worked at this point for nine months. It was

necessary to relocate the highway up on the face of the bluff and the location was so confined at this point that after the highway was completed and placed in service it was necessary to lay a narrow gage track in it and plank it over for the use of the contractor in excavating the first cut for the railroad alongside, by loading into cars standing on the highway. In this way, however, the highway was kept in service with the exception of one day when the shovel was moving down the highway to cut in. In that portion of the line north of Knapps Hill the new highway extended across a bay in the river where one fill of 200,000 cu. yd. was made in deep water.

Grading on this line of railroad is light on the northerly 76 miles, which is through the Okanogan valley. The 58 miles south of Pateros is heavier—the grading on this stretch amounting to 3,194,000 cu. yd. of material, 50 per cent. of which was rock. With the exception of relatively heavy work at one point, near Wenatchee, and for a short distance north of Knapps Hill, Mile 27, these quantities were quite evenly distributed over



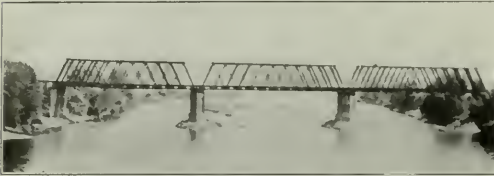
Typical Rock Formation Encountered at Tunnel Portal

the distance. About 90 per cent. of the material was moved by steam shovels and the remainder by station men. Ten steam shovels in all were employed.

Three tunnels of 442 ft., 755 ft. and 383 ft., respectively, were required. All three were driven from top headings, working from one end only. The southerly tunnel was driven entirely by hand. As the material encountered was solid rock it was only necessary to line the portals with timber. The hard character

of this material is shown in one of the accompanying photographs.

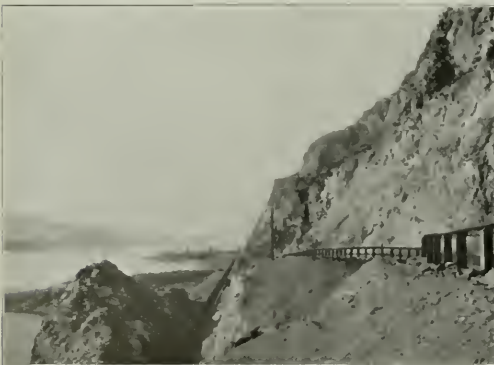
Five rivers are crossed which require truss bridges. The Wenatchee river is crossed about $2\frac{1}{2}$ miles north of Wenatchee, on three 150-ft. Howe truss spans. At Entiat the line crosses the Entiat river on one 150-ft. Howe truss, while the crossing of the Chelan river at Chelan Falls is made on three 150-ft. and one 100-ft. Howe truss spans. The Okanogan river is crossed near Wakefield on two 60-ft. and one 190-ft. Howe trusses, the latter being a draw span. The Methow river is crossed at Pateros on one 150-ft. through Howe truss and one 100-ft. through Howe truss. These bridges were all built of



Howe Truss Bridge Across Wenatchee River

dressed timber, creosoted. The timbers were framed in the material yard at Olds, and after framing all exposed surfaces were given a further brush treatment with creosote. Timber trusses are unusual in most parts of the country, but the arid climate here gives these structures a relatively long life, while fir timber is comparatively cheap, and steel high in price on account of the long haul. Several large timber bridges have recently been built in this vicinity, notably that of the O.-W. R. & N. across the Columbia river, near Kennewick. The photograph of the Wenatchee river bridge shows a typical structure on this line, supported on pile foundations and surrounded by cribs filled with rock, which are in turn protected by heavy riprap.

Corrugated iron culvert pipe was used for small openings under all fills up to 15 ft. in height. Above that height, cast iron



Typical Heavy Highway Reconstruction Work

pipe was used for openings up to 36 in. in diameter. A few small concrete culverts were built at points requiring larger openings than these pipes.

The stations were located at intervals of about five miles, at which points the grading was completed for a 2,000 ft. passing track and a house track, although with the exception of Entiat, only the passing tracks were laid. No intermediate yards or fuel stations were built between Oroville and Wenatchee, but water stations were built at intervals of 20 miles. With the exception of one gravity supply, the water was secured from wells as the river was either too far distant or the lift was too great.

The track was laid with 68-lb. rail on fir ties and gravel ballast by the contractor, using a Roberts track laying machine.

The line was built under the direction of A. H. Hogeland, chief engineer, of the Great Northern, and Ralph Budd, formerly chief engineer, and now assistant to the president; A. F. Whitcomb was district engineer in immediate charge; Guthrie, McDougall & Company, of Portland, Ore., were contractors for the grading, bridge work and track laying.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION

A report of the opening sessions of the Tool Foremen's Association convention was published in the *Railway Age Gazette* of July 24, page 168. Following is a report of the concluding sessions:

TOOL ROOM GRINDING

W. C. Diebert (Chesapeake & Ohio): Considerable difficulty is experienced in grinding tools without automatic machines. At Clifton Forge, Va., we have made a surface grinder, an automatic reamer grinder, a small die grinder and a grinder for the Ingersoll milling machine cutters. This latter machine will cut up to 14 in. in diameter and grind the radius on the cutters used in channeling out driving rods. Wheel lathe tools are given an angle clearance of 7 deg.

J. C. Bevelle (El Paso & Southwestern): The tools issued from the tool room on check are all ground in the tool room. To insure a reasonable life for a drill it should be properly ground at the point. The two cutting edges must be exactly of the same length and should be at an angle of 59 deg. for ordinary purposes. The angle of lip clearance should be about 12 deg. This angle, however, should gradually increase as the center of the drill is approached until the line across the center of the web stands at an angle of 135 deg. with the cutting edges. For heavy cuts in soft material the angle of lip clearance may be increased to 15 deg. The failure to give sufficient angle of lip clearance at the center of the drill is the principal cause of splitting drills up the web. Standard reamers should be kept sharp and properly ground, otherwise a great deal of time will be wasted by the men using them. In the shop at El Paso, Tex., the reamers are not placed in the rack until they have been inspected and put in first-class condition.

Owen D. Kinsey (Illinois Central): Our grinding machinery is placed as far from the precision machinery as possible to avoid trouble from dust and it is in a position to command good light and ventilation. The spindles of all the grinding machines have been made standard so that the grinding wheels may be interchanged. They are also provided with substantial safety hoods and fixtures for every operation. Instructions have been posted on each machine showing the belt position for grinding wheels of different diameters. Success or failure in grinding operations depends directly on the proper selection of wheels for the particular work in hand. We have found that a cool free cutting wheel is the most economical in the long run, even though the wheel life is shorter. The heaviest cutters we handle are 10 in. by 20 in. peg cutters. These are ground on a Bath universal grinder using a radius arm projecting from an arbor upon which the cover is mounted.

Thomas F. Eaton (Baltimore & Ohio): There are 70 grinding wheels in service at the Baltimore shops and it has been found expedient to have one man inspect all the wheels throughout the plant rather than to have each department look after its own. By this means we are kept posted as to the condition of the bearings, the safeguards and the balance of the wheel and are enabled to keep the wheels in safe and efficient running condition. A large number of high speed steel frame reamers and drills have been reclaimed by welding new shanks on by the oxy-acetylene welding process.

Discussion.—Many of the members have experienced considerable difficulty in grinding high speed steel wet, it being found that the tools will split and chip off. For that reason